Evaluation of surveillance system changes to improve detection of disseminated gonococcal infections in Virginia, 2018–2021

River A. Pugsley, PhD, MPH[1,2], **Gracia Gadju, MPH**[2], **Kaylah Young, MPH**[2], **Cameron Rose, MPH**[2], **Nan Haugan, MPH**[2], **Oana Vasiliu, MS**[2]

[1]Centers for Disease Control and Prevention; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention; Division of STD Prevention

[2]Virginia Department of Health; Office of Epidemiology; Division of Disease Prevention; STD Prevention and Surveillance

Abstract

Background: Disseminated gonococcal infection (DGI), a complication of untreated gonorrhea, is rarely reported through routine surveillance. We sought to improve local surveillance system capacity to estimate and monitor the incidence of DGI in Virginia.

Methods: We modified surveillance protocols to identify possible DGI cases using information extracted from gonorrhea case reports and performed provider follow-up using standardized case report forms to confirm DGI diagnosis and collect clinical information. Suspect cases included those with a laboratory report indicating sterile site of specimen collection (e.g. blood, synovial fluid) and/or intravenous (IV) treatment. We performed descriptive analyses to summarize characteristics of suspect and confirmed DGIs and estimated incidence.

Results: After piloting protocols in 2018–2019, we identified 405 suspect DGI cases from 29,294 gonorrhea cases reported in 2020–21 (1.4%). We initiated investigations for 298 (73.6%) of the suspect cases, received provider responses for 105 (25.9%), and confirmed 19 (4.7%) DGI cases. Positive laboratory reports from non-mucosal sites were the most reliable predictor of confirmed DGI status, but most were not confirmed as DGI even when provider follow-up was successful. The confirmed and estimated incidence of DGI was 0.06% and 0.22% respectively. Sixteen (84%) of the confirmed cases were over 25 years of age, 3 (16%) were HIV-positive, and approximately half were male and non-Hispanic black. The majority (15, 74%) were hospitalized, and common manifestations included septic arthritis and bacteremia.

Conclusions: We improved surveillance for DGI in Virginia while incurring minor programmatic costs. Additional efforts to improve the completeness and quality of surveillance data for DGI are needed.

Short Summary

Corresponding Author: River Pugsley, PhD, MPH, Virginia Department of Health, Division of Disease Prevention, 109 Governor Street, 2nd Floor, Richmond, VA 23219, Phone: (804) 864-8039, Fax: (804) 864-7970, river.pugsley@vdh.virginia.gov and npj5@cdc.gov.

Minor modifications to routine STD surveillance protocols in Virginia resulted in improved surveillance of disseminated gonococcal infections, which we estimate occurred among 0.22% of all gonorrhea cases reported from 2020–2021.

Keywords

disseminated gonococcal infection; gonorrhea; surveillance; Neisseria gonorrhoeae

Introduction

Gonorrhea is the second most commonly reported sexually transmitted infection (STI) in the United States. After a historic low in 2009, national rates increased by 118% by 2021, mirrored by a 69% increase in Virginia over the same period.[1,2] *Neisseria gonorrhoeae* generally infects mucosal sites exposed to bacteria during sexual contact, including both urogenital and extragenital sites (e.g., oropharynx and rectum). Disseminated gonococcal infection (DGI) may occur when untreated gonorrhea invades the bloodstream and spreads to distant sites in the body.[3] This rare complication can lead to various clinical findings such as septic arthritis, polyarthralgia, tenosynovitis, petechial/pustular skin lesions, bacteremia, or, on rare occasions, endocarditis or meningitis.[3–6] Given the recent increase in gonococcal infections, one would expect to observe a corresponding increase in the occurrence of DGI. However, available surveillance data on DGI are limited. Historically, DGI has been estimated to occur in 0.5–3% of untreated gonorrhea cases, yet more recent surveillance-based estimates of DGI occurrence among reported gonorrhea cases have been much lower (<0.1%).[3,7]

After a cluster of DGI cases was reported from Michigan in 2019,[8] the Centers for Disease Control and Prevention (CDC) issued updated guidance surrounding the surveillance for DGI.[9] Also in mid-2019, the Virginia Department of Health (VDH) was contacted by a local clinician who had recently diagnosed and treated several patients with DGI. They inquired whether this observed frequency of DGI was common or a reason for concern. However, local baseline incidence data for DGI, key to identifying an unusual occurrence of disease, was not being routinely collected. Assuming DGI occurs in 0.5% of all untreated gonorrhea cases, approximately 100 individuals would progress to disseminated infections each year in Virginia (there were 13,612 cases reported in 2019, and assuming that only 38% of all infections were reported,[10] that leaves 21,798 unreported and presumably untreated cases); yet only three cases were reported in 2019. DGI is often a clinical diagnosis based on nucleic acid amplification test (NAAT) or culture specimens from mucosal (urogenital/extragenital) sites of sexual exposure, with culture specimens from affected disseminated sites (i.e., blood, skin, synovial fluid, or cerebrospinal fluid [CSF]) used to confirm diagnosis.[5] Passive case reports for gonorrhea generally contain only basic demographic, laboratory, and treatment information, which is insufficient to determine DGI status. Clinical manifestations are rarely reported and routine surveillance investigations for gonorrhea are uncommon.

We sought to improve local surveillance system capacity to detect DGIs by developing, piloting, and implementing new surveillance procedures for the investigation of suspected cases identified using data extracted from routine case reports and electronic laboratory reports. We wanted to determine whether relatively minor surveillance system modifications would allow us to estimate the incidence of DGI in Virginia, monitor for the occurrence of outbreaks, and improve our understanding of the demographic and clinical characteristics associated with disseminated infections.

Materials and Methods

We retrospectively analyzed routinely collected public health surveillance data reported to the health department between 2018 and 2019 to identify reported gonorrhea cases with suspected DGI. We identified suspect cases by writing SQL code to search: 1) paper-based and electronic laboratory report (ELR) text fields for specimens collected from disseminated sites of infection such as blood/serum, joints, synovial fluid, cerebrospinal, and wounds or lesions (hereafter referred to as "laboratory criteria"); and 2) provider reports for cases treated with intravenous (IV) ceftriaxone (or an alternative IV regimen), which is usually reserved for systemic infections (hereafter referred to as "treatment criteria").

Based on the results of this preliminary analysis we created a new process, using SQL code that was run monthly, to prospectively identify and flag suspect DGI cases for follow-up by surveillance staff. We developed protocols to guide staff in their provider outreach efforts and added a new data field to the statewide STD surveillance data system to capture DGI status for gonorrhea cases. We used an early draft of CDC's DGI Case Reporting Form as a template to compile an abbreviated list of critical data fields that we incorporated into a data collection tool used to solicit information from providers via fax.[9] For confirmed cases, this included information about clinical presentation and manifestations, hospitalization, course of treatment, and any other relevant medical outcomes.

In early 2020, we piloted these surveillance protocols by conducting provider follow-up for a sample of 20 (12%) of the suspect DGI cases to verify DGI diagnosis and obtain additional clinical information. Once flagged as suspect, STD program staff opened a field record (FR) for the case and assigned it for surveillance follow-up. This type of follow-up was distinct from the field follow-up undertaken by Disease Intervention Specialists (DIS) and occurred remotely from the central office rather than in-person. After initial outreach to confirm contact information, staff made two attempts to contact each provider via fax over a 2–3 week period, followed by at least one additional attempt via phone to reach providers that did not respond to initial contact attempts. Verbiage on the fax-back form defined DGI and the reason for outreach. In limited cases, staff were able to access electronic health records directly to confirm diagnosis.

After these surveillance follow-up activities, we classified suspect cases as either confirmed based on clinical or laboratory criteria, not a case, or unknown if we failed to receive a provider response. Following the CDC working definition, cases were considered confirmed based on laboratory criteria if *N. gonorrhoeae* was isolated or detected from a disseminated site of infection by culture.[9] Cases were also considered confirmed if *N. gonorrhoeae* was

isolated or detected from a mucosal site (e.g., urogenital, rectal, or pharyngeal) by culture or nucleic acid amplification test (NAAT) and any of the following clinical symptoms were present: septic arthritis, polyarthralgia, tenosynovitis, petechial/pustular skin lesions, bacteremia, endocarditis, or meningitis. We conducted medical chart reviews for confirmed cases when available.

Following the pilot period, we revised the suspect DGI identification and follow-up protocols and integrated suspect DGI investigations into ongoing enhanced surveillance activities for 2020–2021, including dedicated staff time for this project. We then analyzed the data collected over these two years to evaluate our surveillance process and estimate the incidence of DGI in Virginia. The two denominators used for incidence calculations were all reported gonorrhea cases and the estimated 2020 U.S. Census population of Virginia. For suspect cases missing a provider response, we attempted to extrapolate DGI case status using the data for cases with responses. We did this by applying the confirmation rate by flag type (i.e., flagged based on laboratory criteria, treatment criteria, or a combination of both criteria) to all cases missing provider responses. Numerators for incidence calculations therefore included all confirmed DGI cases, and also a combination of confirmed and estimated cases. For all confirmed DGI cases, we summarized information on basic demographics (age, race/ethnicity, and gender), gender of sex partners, clinical manifestations, co-infections, and underlying medical conditions.

We evaluated the cost and added value of DGI surveillance activities to inform programmatic recommendations for future DGI surveillance efforts in Virginia. This included an assessment of estimated staff time required, provider responsiveness, the utility (positive predictive value) of the criteria used to identify suspect cases, and internal discussions regarding the practical benefit of collecting DGI data. This evaluation was determined to be non-research: public health practice intended for program improvement in accordance with United States federal law 45 CFR 46.102(d).

Results

During the two-year pilot surveillance period from 2018–2019, we identified 317 suspected cases of DGI from 25,560 reported gonorrhea cases (1.2%); nearly equal numbers were identified using laboratory and treatment criteria (Table 1). There were 11 previously confirmed clinician-reported DGI cases diagnosed in 2018–19; they were all appropriately flagged as suspect DGI cases using these criteria. From the sample of 20 suspect DGI cases selected for follow-up investigations with medical providers, we confirmed one case. The other sampled cases were either data reporting errors by the laboratory or provider (4, 20%), not DGI (7, 35%), or remained unknown due to provider non-response (8, 40%).

After implementation of new DGI protocols in 2020, we identified 405 suspect cases of DGI out of 29,327 gonorrhea cases (1.4%) reported to VDH between January 1, 2020 and December 31, 2021. This included 222 (55%) cases that met laboratory criteria, 169 (42%) cases that met treatment criteria, and 14 (3%) cases that met both criteria. STD program staff initiated provider follow-up attempts for 298 (74%) of these suspect cases, but achieved only a 35% provider response rate (Figure 1). Not all suspect cases were investigated due to

intermittent staffing. Of the 105 cases with provider responses, 18 were confirmed as DGI (10 in 2020 and 8 in 2021), while 87 were not DGI. One additional confirmed case was reported independently by a medical provider in 2021. The majority of the cases flagged as suspect DGI but determined to not be DGI after provider follow-up were due to data reporting errors, predominantly either incorrect specimen source (e.g., blood accidentally recorded instead of urine) or incorrect treatment method (e.g., IV accidentally recorded instead of IM [intramuscular]). All laboratory specimen reporting errors occurred prior to health department receipt.

The majority of confirmed cases (14 out of 19) were identified based on disseminated sites of specimen collection (i.e., laboratory criteria), while only one case was identified based solely on IV treatment (i.e., treatment criteria). Three cases met both criteria. Overall, we confirmed 100% of suspect cases that met both criteria (n=3), as well as 20% (n=14) of those that met the laboratory criteria. In contrast, the likelihood of finding confirmed DGI cases based on the treatment criteria was extremely low (3%, 1 case). Of the suspect DGI cases with no provider response, 110 met the laboratory criteria, 74 met the treatment criteria, and 9 met both criteria. By applying the confirmation rates by suspect criteria type to these counts, we estimated that an additional 46 cases of DGI likely occurred (36 in 2020 and 29 in 2021), for a total of 65 DGI cases over the two-year enhanced surveillance period (Table 1).

Focusing on the 19 confirmed DGI cases, we found that 0.06% of all reported gonorrhea cases progressed to DGI in 2020–2021, yielding an observed incidence of 0.11 per 100,000 population annually (using the 2020 Census estimated population for Virginia). After combining the number of confirmed cases with estimated cases, we extrapolated that DGI affected 0.22% of all reported gonorrhea cases (65/29,327). Subsequently, the estimated incidence of DGI from 2020 to 2021 was 0.38 per 100,000 population annually. We also retrospectively applied this same extrapolation formula to the 2018–2019 data. The number of suspect cases identified based on laboratory criteria was highest in 2020, as were the number of both confirmed and estimated DGIs, before cases declined slightly in 2021 (Figure 2).

Slightly over half of all cases of both gonorrhea and confirmed DGI occurred among males and individuals reported as non-Hispanic black (Table 2). While diagnoses of both (GC and DGI) were most common among those aged 25–39 years, DGI was more likely to occur among older age groups; 37% of confirmed DGI cases were between 40–64 years of age, compared to only 11% of overall gonorrhea cases. HIV co-infection was more common among gonorrhea cases that developed DGI (16% vs. 5%), although these estimates were hindered by small numbers.

Most confirmed DGI cases had gonococcal bacteria isolated from either blood specimens (9 cases, 47%) or joint/synovial fluid (7 cases, 37%). Other positive sites of gonococcal infection included urogenital, rectal, and pharyngeal (Table 3). Although three-fourths (14) of cases were hospitalized, all persons recovered. Cases were hospitalized for a median of 6 days (range 0–21 days). The most frequent clinical manifestations were septic arthritis (10, 53%) and bacteremia (8, 42%); cellulitis, polyarthralgia, and hepatitis were also

documented. STI co-infections were common (11, 57%); 3 cases had concurrent human immunodeficiency virus (HIV) infection, 2 cases were diagnosed with syphilis, 4 cases with chlamydia, and 2 cases with Hepatitis C. Three had histories of previous gonorrhea infection. About half (10, 53%) of the cases presented with underlying conditions; 3 with past or present drug/alcohol misuse, 5 with mental or neurological disorders, and 2 with type 2 diabetes. Gender of recent sex partners was unknown for 12 of the 19 DGI cases. Among the 4 male DGI cases for whom gender of sex partners was documented, one reported sex with men.

Our assessment of the programmatic costs associated with conducting DGI surveillance in Virginia found minimal burden. Because of the relatively small numbers of suspect cases flagged by our algorithm (approximately 200 cases per year, or 17 per month), the extra tasks associated with conducting provider follow-up for DGI surveillance were covered by the addition of one part-time surveillance staff located in the central office. We estimated that follow-up for each suspect case required approximately one hour of staff time, resulting in an annual staffing cost of less than $8,000. The modifications to existing STD surveillance data systems, which were necessary in order to capture new DGI-related data fields, were made in-house by surveillance staff without incurring any new development costs.

Discussion

Anecdotal reports of DGI, or other unusual manifestations of STIs, are insufficient to inform actionable epidemiological analysis. Relatively minor revisions to surveillance data systems and protocols allowed us to capture useful data on this previously under-surveilled condition in Virginia. Using revised protocols, we were able to identify 18 confirmed DGI cases in 2020–2021 that would have otherwise been missed (out of 29,327 reported gonorrhea cases). Throughout the initial pilot and enhanced surveillance period, flagging cases based on laboratory reports indicating sterile (non-mucosal) anatomical sites of specimen collection was the most reliable indicator of actual DGI diagnosis. Notably, surveillance follow-up investigations to confirm DGI diagnosis were crucial, as most suspect cases were flagged due to data reporting errors and were not true disseminated infections. Even relying solely on atypical laboratory reports to assign DGI status would have resulted in misclassifying 77% of the suspect cases (based on those with provider responses). This highlights the limitations inherent in using notifiable surveillance system data to detect DGI.

Our surveillance-based estimate of DGI occurrence (0.06% confirmed, 0.22% estimated) is lower than that reported historically for untreated gonococcal infections (0.5–3%),[3] but similar to more recent population-based surveillance estimates based on reported infections. Researchers in the United States who analyzed the burden of culture-confirmed DGI cases through the Active Bacterial Core surveillance (ABCs) program from 2015–2019 found that DGI developed in 0.06% of all reported gonorrhea cases within the selected surveillance areas.[7] Our methods and findings are also similar to those recently undertaken in North Carolina (0.05–0.15%) and California (0.24%).[11,12] Importantly, only the most severe cases of DGI are likely to be detected; milder symptoms may go unrecognized and clinical diagnosis requires a high index of suspicion.[13]

While the risk factors for gonorrhea in general are well understood, the same is not true for the predictors of DGI. It may occur more frequently among persons with untreated gonococcal infections, which is of particular concern given recent disruptions to STD screening and care services in the U.S. due to the COVID-19 pandemic. Others have posited the likelihood of increased DGI incidence during this period due to the likelihood of reduced screening and delays in treatment, and have found some evidence to support this hypothesis.[12,14] Our analysis coincided with the COVID-19 pandemic, allowing us to compare the incidence of suspect DGI before and during this period. We found that the number of suspect DGIs in Virginia increased in 2020, particularly for cases with positive laboratory results from sterile specimen collection sites (80% increase from the 2018–2019 average). The number of confirmed and estimated DGIs also rose in 2020, although not possible to ascertain whether these observed increases represent a true increase in incidence versus an artifact of surveillance.

Demographic and clinical data collected from medical records of confirmed DGI cases in Virginia showed similar trends to other recent studies both within the United States and internationally, indicating a shift away from populations historically most at risk of DGI such as women and younger individuals.[6,15] Within the last five years, reports from across the United States found that the majority of cases occurred among men (mirroring trends in reported gonorrhea cases) and have an older age distribution than the average for gonorrhea.[7–8,12–13,16–17] Similarly, studies from France and England both found that DGI cases skewed male and slightly older.[18,19] These demographic shifts may reflect the changing epidemiology of gonorrhea in general over the last several decades, with both gonorrhea and DGI increasingly occurring among males and persons in older age groups, living with HIV, using drugs, and with other co-morbidities.[7] Rates of both gonorrhea and DGI have remained inequitably high among black and other minority groups. We found that individuals with confirmed DGI were roughly twice as likely be reported as non-Hispanic white relative to those with routine gonococcal infections (42% vs. 21%). While the extent of racial disparity in gonorrhea rates is reduced among older age groups, it is unclear whether our observation represents a true difference in DGI occurrence or is simply the result of random variation due to small case counts.[1]

Our activities were primarily intended as a source of baseline surveillance data, rather than to collect detailed clinical information, although we did request medical charts from providers for confirmed cases. In terms of hospitalizations and clinical manifestations of DGI, our findings again concur with other recent studies.[8,13,18,20] Of note, we found that 74% of confirmed cases were hospitalized, likely a reflection of only the most severe cases being identified by clinicians. The most common manifestations noted in our review of medical charts were septic arthritis and bacteremia.

The flexibility of local surveillance data systems was of critical importance to these efforts, as we were able to capture new DGI-specific data fields without incurring additional development costs. This system flexibility has proven crucial not just for DGI, but also for other local surveillance initiatives and outbreak response efforts. Since DGI is a relatively rare sequelae of gonorrhea, the additional workload burden attributable to DGI public health investigations was low. Because of federal STD prevention funding for enhanced case-based

gonorrhea surveillance, the health department now has dedicated staff available to conduct enhanced surveillance who can be intermittently re-tasked to other surveillance priorities, such as DGI investigations, without major disruption.[21] We further minimized costs by conducting all provider follow-up via phone and fax from the central office, as opposed to delegating to the field.

Our DGI surveillance efforts were hindered by low provider response rates to our investigation outreach attempts. Thus, we believe that confirmed DGI case counts were an underestimate of the true burden. However, our goal was not to capture every case of DGI; instead, we sought to develop procedures for the estimation of DGI from available surveillance data. Field investigations and the involvement of trained DIS would likely improve this response rate, but would also substantially increase program costs and pull field staff away from other priorities. Expanding direct access to electronic medical records would greatly facilitate future investigations of DGI and enable better characterization of cases. Legally the health department has the authority to request medical records for patients diagnosed with notifiable conditions, but practically obtaining access may be complicated. Existing records access agreements between the STD program and local hospital systems are limited and do not cover all facilities that diagnose DGI. The expansion of electronic case reporting may also improve available data. For now, this highlights a need to foster improved relationships and communication with local providers both to increase clinical awareness of DGI and to enhance reporting of rare presentations of common infections such as gonorrhea and syphilis.

Finally, antibiotic resistance remains a significant concern for all gonococcal infections, and monitoring trends in antimicrobial susceptibly could help inform DGI treatment recommendations.[22] The CDC recommends that specimens from exposed mucosal and sterile sites should be collected and all confirmed isolates sent to reference laboratories for antimicrobial susceptibility testing (AST).[5] Other recent studies of DGI have been able to incorporate AST for some isolates; thus far all remained susceptible to ceftriaxone.[7–8,12,23] Unfortunately, we were unable to incorporate AST into our surveillance efforts. Most local laboratories lack the capacity to perform such testing, the state public health laboratory in Virginia does not routinely conduct STI testing, and the process of forwarding specimens to a reference laboratory is often not feasible for local providers.

Even without AST, we were able to improve local capacity to conduct surveillance for DGI in Virginia through this initiative while incurring minor costs, but additional measures need to be taken to improve the comprehensiveness and quality of these surveillance data moving forward. It is our hope that improved detection of DGI will translate to a better understanding of the populations most at risk, and ultimately inform broader provider outreach efforts to prevent gonococcal complications. While rare, DGI is more prevalent than previously recognized, and we concur with our colleagues in California that many DGI cases are still occurring "under the surveillance radar."[24] We need to systematically improve the ability of our STD programs and surveillance data systems to detect both DGI as well as other concerning sequalae of sexually transmitted infections.

Acknowledgements:

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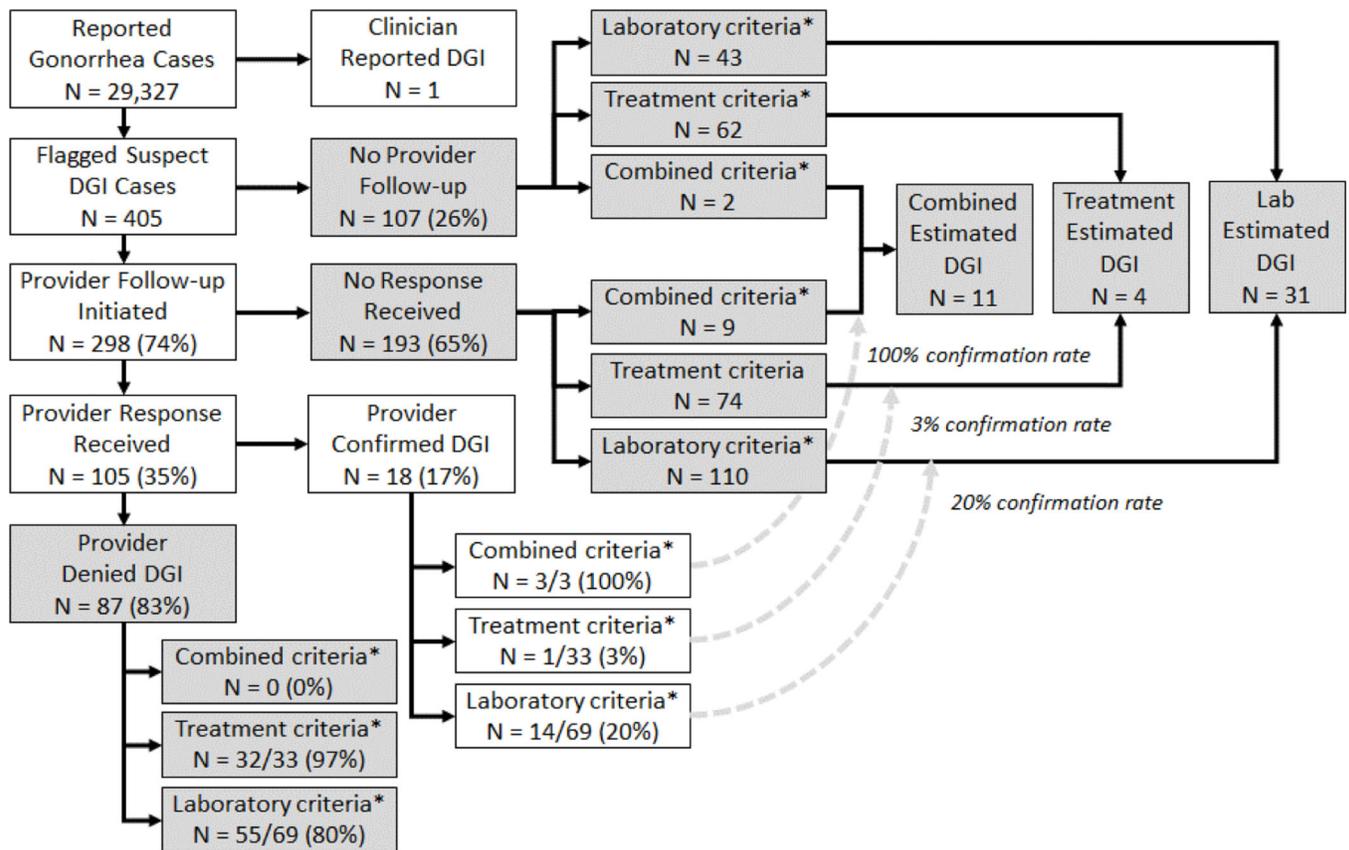
Figure 1. Flow chart of suspected disseminated gonococcal infection (DGI) case investigation outcomes, Virginia, 2020–2021.

* Reported gonorrhea cases met the treatment criteria for suspect DGI if there was any type of intravenous (IV) medication treatment noted in the surveillance record. Cases met the laboratory criteria for suspect DGI if there was any indication in the laboratory report that the specimen was collected from a normally sterile (non-mucosal) site, such as blood or joint/synovial fluid. Cases met the combined criteria for suspect DGI if they met both the treatment and laboratory criteria.

Figure 2. Number of suspected and estimated disseminated gonococcal infections (DGI) by year in Virginia, 2018–2021*

* Reported gonorrhea cases met the treatment criteria for suspect DGI if there was any type of intravenous (IV) medication treatment noted in the surveillance record. Cases met the laboratory criteria for suspect DGI if there was any indication in the laboratory report that the specimen was collected from a normally sterile (non-mucosal) site, such as blood or joint/synovial fluid. Cases met the combined criteria for suspect DGI if they met both the treatment and laboratory criteria.
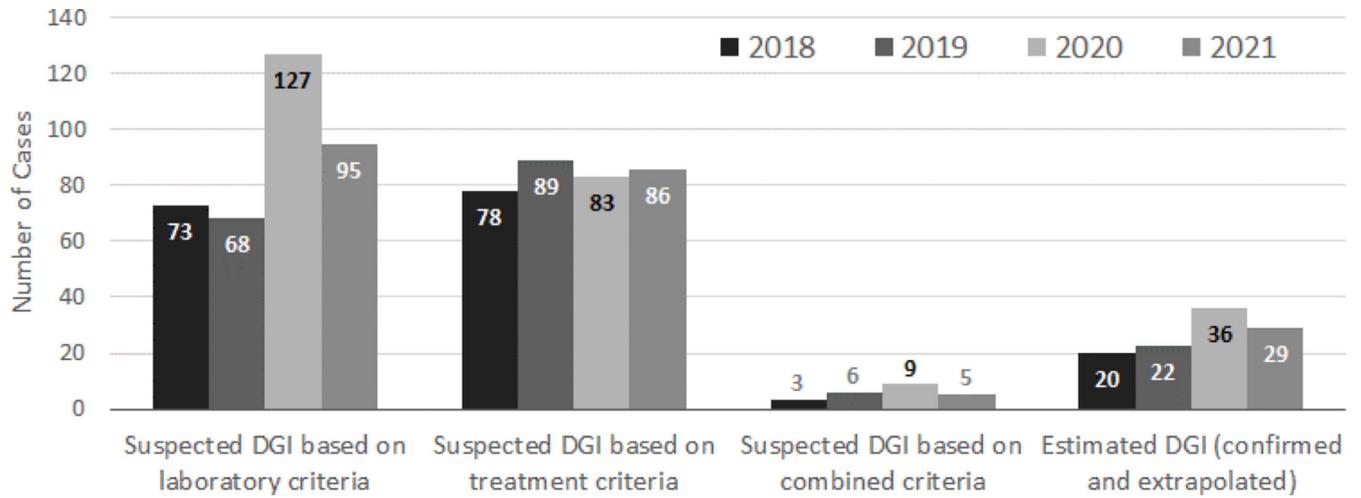
Table 1.

Outcomes of surveillance follow-up investigations with medical providers to confirm gonorrhea cases identified as possible disseminated gonococcal infections (DGI) in Virginia, 2018–2021

Case Investigation Status, *N (% of previous row)*	Pilot Surveillance Period		Enhanced Surveillance Period	
	2018	**2019**	**2020**	**2021**
Suspect DGI based on any criteria [*]	**154**	**163**	**219**	**186**
Surveillance investigation initiated	0	20 (12%)	157 (72%)	141 (76%)
Provider response received	--	12 (60%)	61 (39%)	44 (31%)
DGI confirmed	--	1 (8%)	10 (16%)	8 (18%)
Suspect DGI based on laboratory criteria alone [*]	**73**	**68**	**127**	**95**
Surveillance investigation initiated	0	9 (13%)	86 (68%)	93 (98%)
Provider response received	--	5 (56%)	42 (49%)	27 (29%)
DGI confirmed	--	1 (20%)	7 (17%)	7 (26%)
Suspect DGI based on treatment criteria alone [*]	**78**	**89**	**83**	**86**
Surveillance investigation initiated	0	11 (12%)	64 (77%)	43 (50%)
Provider response received	--	7 (64%)	17 (27%)	16 (37%)
DGI confirmed	--	0 (0%)	1 (6%)	0 (0%)
Suspect DGI based on both criteria combined [*]	**3**	**6**	**9**	**5**
Surveillance investigation initiated	0	0	7 (78%)	5 (100%)
Provider response received	--	--	2 (29%)	1 (20%)
DGI confirmed	--	--	2 (100%)	1 (100%)
All reported gonorrhea cases [†]	**11,970**	**13,590**	**14,958**	**14,369**
DGI reported independently by providers	3	8	0	1
DGI confirmed via surveillance follow-up	0	1	10	8
DGI extrapolated from surveillance responses [‡]	17	13	26	20
Total estimated DGI *(% of all reported cases)* [§]	**20 (0.17%)**	**22 (0.17%)**	**36 (0.24%)**	**29 (0.20%)**

[*] Reported gonorrhea cases met the treatment criteria for suspect DGI if there was any type of intravenous (IV) medication treatment noted in the surveillance record. Cases met the laboratory criteria for suspect DGI if there was any indication in the laboratory report that the specimen was collected from a normally sterile (non-mucosal) site, such as blood or joint/synovial fluid. Cases met the combined criteria for suspect DGI if they met both the treatment and laboratory criteria.

[†] Includes all gonorrhea cases diagnosed in 2018–2021 and reported to the Virginia Department of Health as of March 31, 2022.

[‡] The extrapolated number of missed DGI cases was derived by multiplying the number of suspect cases without provider responses by the confirmation rate for each criteria category (laboratory, treatment, or combined) for similar suspect cases with provider responses.

[§] The estimated total number of DGI cases was derived by combining the number of provider confirmed DGI with the extrapolated number of missed DGI cases.

Table 2.

Epidemiological characteristics of all gonorrhea cases, suspected disseminated gonococcal infections (DGI) based on sterile (non-mucosal) sites of specimen collection, and confirmed disseminated gonococcal infections in Virginia, 2020–2021

Characteristic	Reported gonorrhea cases[*] N (%)	Suspected DGI N (%)	Confirmed DGI N (%)
Gender at diagnosis			
Male	16,072 (54.9%)	118 (50.0%)	10 (52.6%)
Female	13,137 (44.8%)	117 (49.6%)	8 (42.1%)
Transgender [†]	83 (0.3%)	1 (0.4%)	1 (5.3%)
Unknown	29	0	0
Age, years			
<15 years	113 (0.4%)	1 (0.4%)	0 (0%)
15–24 years	12,747 (43.5%)	90 (38.1%)	3 (15.8%)
25–39 years	13,135 (44.8%)	104 (44.1%)	9 (47.4%)
40–64 years	3,195 (10.9%)	40 (16.9%)	7 (36.8%)
65+ years	125 (0.4%)	1 (0.4%)	0 (0%)
Unknown	12	0	0
Race/ethnicity			
White	4,774 (21.1%)	58 (28.9%)	8 (42.1%)
Black	16,110 (71.2%)	132 (65.7%)	11 (57.9%)
Hispanic	1,065 (4.7%)	9 (4.5%)	0 (0.0%)
Other	665 (2.9%)	2 (1.0%)	0 (0.0%)
Unknown	6,713	35	0
HIV Status[‡]			
Previous HIV diagnosis	1,300 (4.4%)	11 (4.7%)	3 (15.8%)
New HIV diagnosis	104 (0.4%)	1 (0.4%)	0 (0.0%)
Total	**29,327**	**236**	**19**

[*] Includes all gonorrhea cases diagnosed in 2020–2021 and reported to the Virginia Department of Health as of March 31, 2022.

[†] One confirmed disseminated case identified as male-to-female transgender.

[‡] Determination of previous infection history was based on reported infections captured by the state surveillance data system. We defined previous infection as any case diagnosed more than 30 days prior to the earliest specimen collection date associated with the gonorrhea diagnosis, while new HIV infections were defined as those identified within 30 days before or after this date.

Table 3.

Clinical characteristics of confirmed disseminated gonococcal infections based on surveillance follow-up investigations with medical providers in Virginia, 2020–2021 (*N = 19*)

Characteristic	N (%)
Sterile site(s) of specimen collection	
Blood	9 (47.4%)
Joint or synovial fluid	7 (36.8%)
Muscle, fascia, tendon	1 (5.3%)
Other (lesion, wound, abscess)	1 (5.3%)
None (clinically diagnosed)	1 (5.3%)
Other positive site(s) of infection	
Urine/Urogenital	6 (31.6%)
Anal/Rectal	1 (5.3%)
Oropharynx	1 (5.3%)
None or unknown	11 (57.9%)
Hospitalization status	
Not hospitalized	4 (21.1%)
Hospitalized for 0–3 days	5 (26.3%)
Hospitalized for 4–7 days	4 (21.1%)
Hospitalized for 8–14 days	2 (10.5%)
Hospitalized for 15+ days	2 (10.5%)
Hospitalized for unknown duration	1 (5.3%)
Unknown hospitalization status	1 (5.3%)
Clinical signs & symptoms [*]	
Septic arthritis	10 (52.6%)
Bacteremia	8 (42.1%)
Cellulitis	2 (10.5%)
Polyarthralgia	1 (5.3%)
Hepatitis	1 (5.3%)
Previous infections and co-infections [†]	
Previous gonorrhea infection	3 (15.8%)
HIV co-infection (previous infection)	3 (15.8%)
Syphilis co-infection	2 (10.5%)
Chlamydia co-infection	4 (21.1%)
Hepatitis C co-infection	2 (10.5%)
None or unknown	8 (42.1%)
Other underlying conditions	
Past or current drug and/or alcohol misuse	3 (15.8%)

Characteristic	N (%)
Mental or neurological disorders[‡]	5 (26.3%)
Type 2 diabetes mellitus	2 (10.5%)
Pelvic inflammatory disease (PID)	1 (5.3%)
Generalized myasthenia gravis (GMG)	1 (5.3%)
None or unknown	9 (47.4%)
Gender of sex partner(s) within past 12 months	
Men who had sex with cis-females	3 (15.8%)
Men who had sex with cis-males	1 (5.3%)
Women who had sex with cis-males	3 (15.8%)
Unknown or refused	12 (62.2%)

[*] One case had multiple clinical signs (septic arthritis, bacteremia, cellulitis, and hepatitis). Six cases were missing information, so clinical manifestations for these patients were estimated from the anatomic site of specimen collection as follows: 2 cases with positive blood specimens were assumed to have bacteremia; 3 cases with positive joint or synovial fluid specimens were assumed to have arthritis; and 1 case with a positive wound specimen was assumed to have cellulitis.

[†] Determination of previous gonorrhea and HIV infection history was based on reported infections captured by the state surveillance data system. We defined previous infection as any case diagnosed more than 30 days prior to the earliest specimen collection date associated with the DGI case. Information on concurrent syphilis, chlamydia and hepatitis co-infections was ascertained from medical records. Note that 3 cases had two concurrent co-infections (data not shown).

[‡] Mental disorders recorded in the medical records included: anxiety, depression, bipolar disorder, post-traumatic stress disorder, mental retardation, and unspecified neurological disorder.